

ABSTRACT OF THE DISCLOSURE

A substrate comprising at least two layers which have different thermal expansion coefficients (TECs) is used for subsequent epitaxial growth of semiconductors. A typical example is an epitaxial growth of III-V Nitride (InGaAlBNAsP alloy semiconductor) on sapphire. Due to the thermal mismatch between III-V Nitrides and sapphire, epitaxially-processed wafers bow in a convex manner during cool down after the growth. A layered substrate compensates for the thermal mismatch between the epitaxial layered the top layer of the substrate, resulting in a flat wafer suitable for subsequent processing at high yields. The layered substrate is achieved by attaching to the back side of the substrate a material which has a lower TEC, for example silicon on the backside of the sapphire, to reduce or eliminate the bowing. Silicon is attached or grown on a sapphire wafer by such as wafer bonding or epitaxial growth. Since the above attachment process is done at an elevated temperature, the sapphire on silicon structure may bow in a convex manner at room temperature due to the thermal mismatch. Hence, for the subsequent growth of GaN on the sapphire on silicon wafer, direct heating is desirable rather than heating on a heat sink material. Another example is simultaneous epitaxial growths of GaN on a front side and silicon on the backside of the sapphire. A special growth system for this double-sided growth is also described.